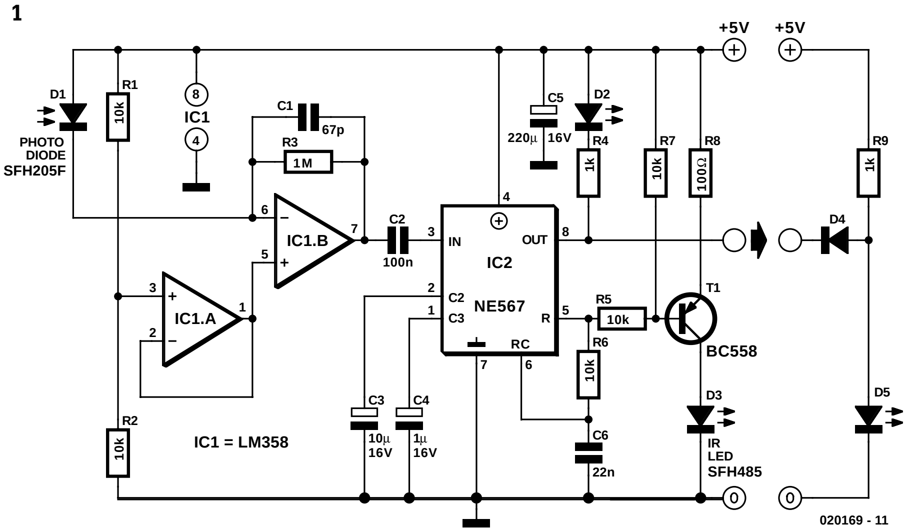
Model Train Identification Circuit

M. Hajer

This circuit is intended to be used to detect trains on a model railway track. It is partially based on designs described in past issues of *Elektor Electronics*. As can be seen from **Figure 1**, it consists of a simple infrared transceiver built around an LM358 and an NE567. With the component values shown in the schematic, it has a working range of around 40 to 50 cm. When several detectors are used, crosstalk among the detectors can be avoided by setting the frequency of the NE567 to a different value for each detector. The LED and series resistor shown at the far right can be added to indicate that a track section is occupied.

The most interesting aspect of this circuit is how it is used. For this, refer to **Figure 2**. If the transmitter and receiver are placed in the 'A' positions, the circuit acts as a 'normal' train detector. The diagonal placement makes it very reliable as a train detector. If instead the transmitter and receiver are placed in the 'B' positions, the circuit can be used for train identification. When a train passes through the gate formed by the diodes in the B positions, the light beam is interrupted at certain intervals, which generates a sort of 'bar code' for the train configuration in question. Using a PC or microcontroller, it is then possible to distinguish various trains from each other using this bar code. This in turn makes it possible to have different trains travel differently on the track, or to handle them differently at the mimic station.

1



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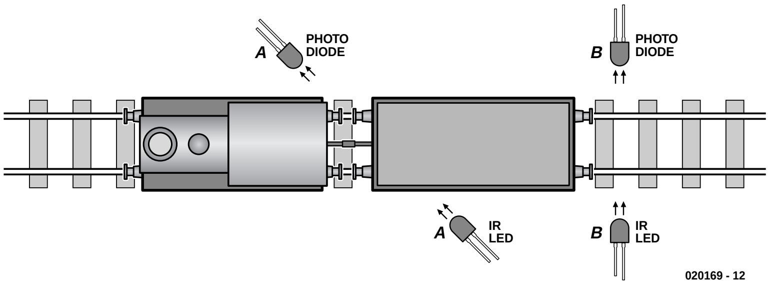

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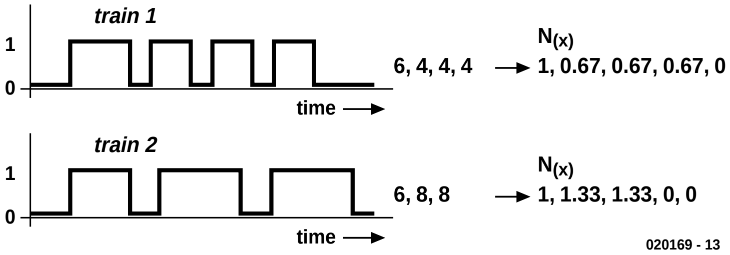

Figure 3 shows two examples of such bar codes. Here train 1 consists of a locomotive with three short wagons, while train 2 has two long wagons. Measuring the lengths of the individual pulses yields the series '6-4-4-4' for train 1 and the series '6-8-8' for train 2. Train speed information can be eliminated by normalising the values to the first number of the series. This yields a series that indicates how long the wagons are relative to the length of the locomotive, regardless of the speed of the train. If zeroes are added as necessary to achieve a certain train length and the detected values are compared with all previously stored train configurations, surprisingly reliable train identification is possible.

The comparison can be performed in a variety of manners. One way that works well is to determine the quadratic error between the measured value and all stored 'reference trains'. However, this method is sensitive to differences in train length, so a reference train with one less wagon will not be recognised. The error estimate can be strongly reduced by taking train length into account (by reducing the reference trains to the same length as the measured train).

The numerical value determined using quadratic error estimation is also a measure of the reliability of the estimate. An error threshold can be used to distinguish between trains that have been recognised and trains that are uncertain. In the author's system, the light gate operates at a frequency of approximately 20 Hz, which yields good train recognition.

A final tip: if you place the transmitter and receiver diodes at the level of the floor of the wagons, you can prevent the light from passing through carriage windows to the receiver. This prevents measurement errors, and it allows flat and open wagons to be properly sensed.

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